DOCUMENT RESUME

ED 270 321 SE 046 624

TITLE	Problem Solving Activities Made to N-Joy. Monograph #1.
INSTITUTION	Association of Mathematics Teachers of New Jersey, Vineland.
PUB DATE	80
NOTE	38p.; For Monograph 2 see ED 262 989.
PUB TYPE	Guides - Classroom Use - Materials (For Learner) (051) -- Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Elementary Education; *Elementary School Mathematics; *Instructional Materials; *Learning Activities; *Mathematics Instruction; *Problem Solving; Student Attitudes; Student Motivation; Word Problems (Mathematics); *Worksheets
IDENTIFIERS	New Jersey

ABSTRACT

This document addresses the need to provide problem-solving materials for teachers of mathematics in the upper elementary grades. The activities are designed to: help teachers emphasize problem-solving techniques, develop positive attitudes toward mathematics and problem solving, provide problems that could be used whenever free time exists, provide non-sequential problem-solving experiences, illustrate that problem solving can be fun, and encourage class and small group discussion. The problems vary in type and topic, spanning the curriculum. Selected sources and an answer key are provided. (MNS)

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PROBLEM SOLVING ACTIVITIES MADE TO N-JOY

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ASSOCIATION OF MATHEMATICS TEACHERS OF NEW JERSEY

monograph #1
1980

SE 046 624

PROBLEM SOLVING ACTIVITIES MADE TO N-JOY

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Teachers of New Jersey

Additional copies of this monograph are available at $2.00 per copy (made payable to AMTNJ) and can be obtained by writing to:

AMTNJ Monograph
c/o Thomas Hooper
Bloomfield Public Schools
155 Broad Street
Bloomfield, NJ 07003

INTRODUCTION

This publication is an attempt to address the various challenges that have recently been directed to the Association of Mathematics Teachers of New Jersey.

The National Council of Supervisors of Mathematics issued a position paper on basic mathematical skills in 1977. It stated:

> "learning to solve problems is the principal reason for studying mathematics. ...Solving word problems in texts is one form of problem solving, but students should also be faced with non-textbook problems. Problem-solving strategies involve posing questions, analyzing situations, translating results, illustrating results, drawing diagrams, and using trial and error. In solving problems, students need to be able to apply the rules of logic necessary to arrive at valid conclusions. They must be able to determine which facts are relevant. They should be unfearful of arriving at tentative conclusions and they must be willing to subject these conclusions to scrutiny."

Elementary and middle school teachers have expressed concern about priorities in mathematics education and in particular, the area of problem solving. In April 1980, the National Council of Teachers of Mathematics offered a set of recommendations for school mathematics in the 1980s. This set of recommendations (An Agenda for Action) has as its first recommendation: "that problem solving be the focus of school mathematics in the 1980s."

As a result of the aforementioned factors, the Executive Council of the AMTNJ decided to sponsor the writing of a publication to meet these needs. The result is this monograph of problem solving activities. This publication is suggested for use in the upper elementary grades. It represents an attempt by the AMTNJ to help the teachers of New Jersey provide enhanced instruction in mathematics on the topic of problem solving.

The activities are designed:

* to help teachers emphasize problem solving techniques
* to develop a positive attitude toward mathematics and problem solving
* to provide problems that need not be done during periods specifically designated for mathematics instruction, but that can be used whenever a bit of free time exists
* to provide a set of non-sequential problem solving experiences
* to illustrate that problem solving can be fun
* to foster the notion that class and/or small group discussion can provide a vital problem solving atmosphere.

Many problem solving activities can be explored by children who are at different levels of achievement with respect to traditional arithmetic skills or concepts. All students should have a variety of problem solving experiences spiraled throughout the year.

In conclusion, the AMTNJ wishes to express its sincere thanks to the authors who gave their time and effort so that this project could be completed. They are:

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NOTES TO THE TEACHER

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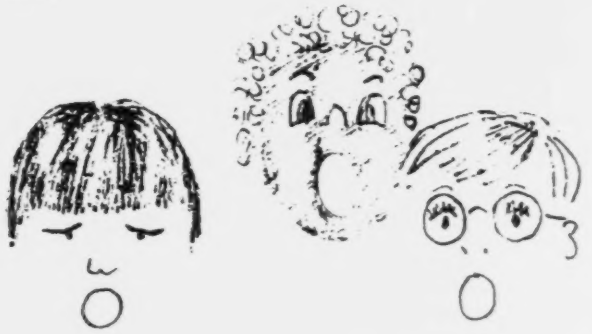


TABLE OF CONTENTS

	Page
Are You For Real?	1
Are You Hexed, Too?	2
Cents and Non-cents	3
Templates for Cents and Non-cents	4, 5
Department of Missing Information	6
Dots, Dots and More Dots	7
Extra!! Extra!! Extra !!	8
Guess My Rule	9
Let's Count	10
Lucky Numbers	11
Name Game	12
News Carriers Use Math Every Day	13, 14
Right Up Shubert's Alley	15
Room To Roam	16
Grid for Room to Roam	17
Sense Or Nonsense	18
Who Took The Dollar?	18
Squares-Rectangles-Triangles	19
Supermarket Math	20
The Black Hole Corridor!	21
The Record Rack	22
The Movies	23
Using Codes To Convey Information	24
Selected Sources	25
Answer Keys	26-30

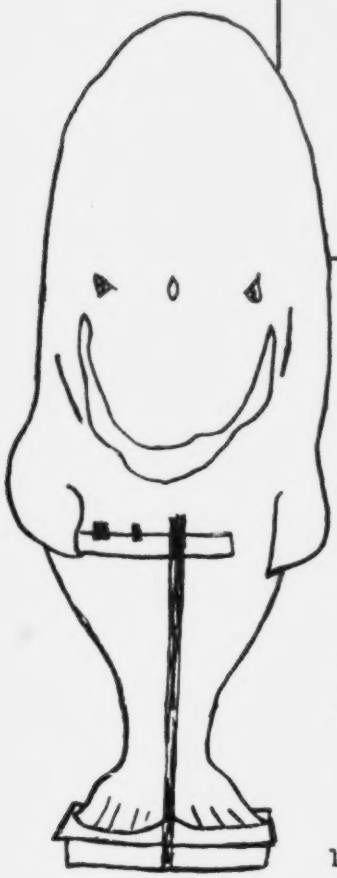
ARE YOU FOR REAL?

Directions:

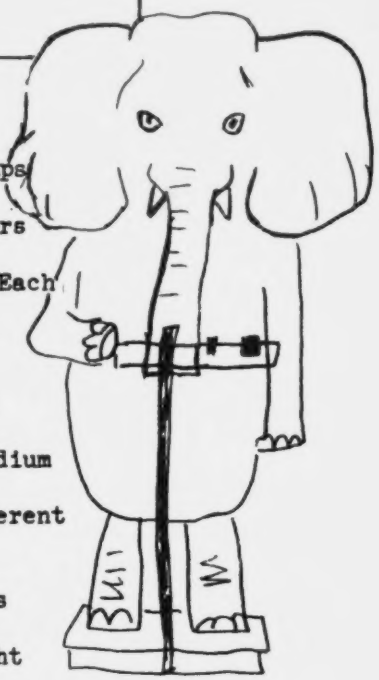
1. Place realistic numbers in the blank spaces.
2. Discuss, and verify where needed, if the numbers selected are appropriate.
3. Formulate problem(s) based on each exercise.
4. Solve the problem(s) formulated.

Example: Maria works at Burger King for ____ hours per week. She is paid ____ per hour.

(Step 1) 9, $3.25
(Step 2) Verify by checking with someone working for Burger King.
(Step 3) How much money does she earn in one week?
(Step 4) $3.25
x 9
$ 29.25



1. Manuel receives ____ packages of stamps each month from a stamp club. There are ____ stamps in each package.
2. The bike shop sells ____ styles and ____ colors for the saddle of a bike.
3. Ellen bought ____ skeins of yarn for a rug. Each skein contains ____ oz. of yarn.
4. Ken watches ____ hours of TV each day.
5. A baby hippopotamus weighs ____ pounds.
6. George takes piano lessons that cost ____ per lesson. Each lesson is ____ minutes long.
7. Yankee Stadium seats ____. The Cleveland Stadium seats ____.
8. A cafeteria has ____ kinds of soup, ____ different salads, and ____ different sandwiches.
9. A gasoline storage tank holds ____ liters of unleaded gasoline. Another storage tank holds ____ liters of leaded gasoline.
10. A blue whale weighs about ____ times the weight of an elephant.



Are You Hexed, Too?
Cut out these 4 weird shapes.
Then try to cut each shape only once
and reassemble the two pieces to form a
hexagon.

CENTS AND NON-CENTS

INCREASE YOUR WEALTH

Cut out the paper coins and bills. Place 30 pennies on a table in a row.

Pick up every second (2nd, 4th, 6th, etc.) penny and replace it with a nickel.
Pick up every third (3rd, 6th, 9th, etc.) coin (all of these will not be pennies) and replace it with a dime.
Pick up every fourth coin and replace it with a quarter.
Pick up every fifth coin and replace it with a fifty cent piece.
Pick up every sixth coin and replace it with a Susan B. Anthony dollar.

1. What is the total amount of money on the table after the five exchanges above have been accomplished?
2. How much more money is there at the end than when you started?
3. How much more was on the table after you placed the dollars than just before this was done?
4. Suppose you placed a five dollar bill in every seventh place after removing every seventh coin. How much more would you have on the table than you had just before you placed the fives?

Suggestion- Pooling your wealth with another, try the above using 50 pennies to start. Then try it using 100 pennies.

EIGHT PENNY PICK-UP

Use eight pennies and try this game with a friend.
At your turn you must pick up one, two, or three pennies. Then your friend must do the same (that is pick up one, two, or three pennies).
Whoever picks up the last penny loses.
Can you work out a plan so that if you go first you can always win?

CATCH 52

Note: This game involves a strategy similar to EIGHT PENNY PICK-UP. It is more abstract, however those students who understand the strategy will enjoy the game.

Two players take turns in picking any whole number from one through six.
The numbers chosen are added as they are picked.
The winner is the player who picks the numbers that make the sum 52 (or CATCHES 52).
The game will take several turns for each player.

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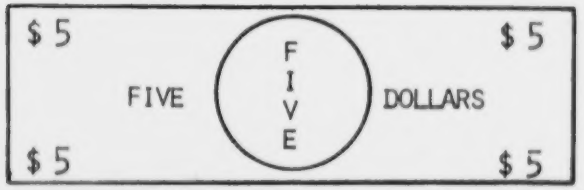
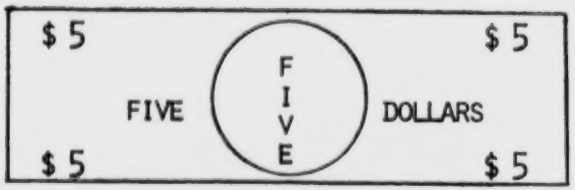
IN GOD WE TRUST
LIBERTY
1974

LIBERTY
IN GOD WE TRUST
1974


$5
FIVE
FIVE
DOLLARS
$5

LIBERTY
1979

LIBERTY
1979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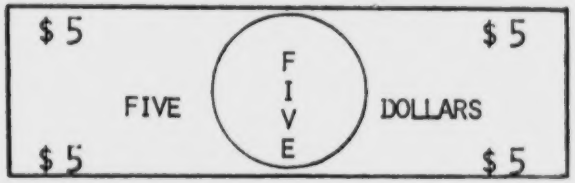
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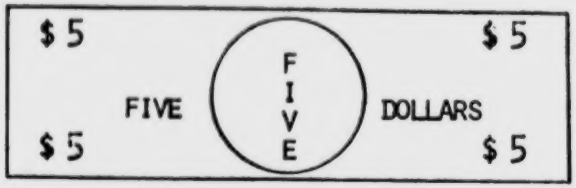
DOLLARS
$5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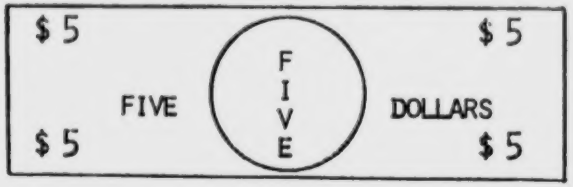

$5
FIVE
FIVE
DOLLARS
$5

DEPARTMENT OF MIS ING INFORMATION

Answer the following questions for each exercise below:

a. Can you do this problem?
b. What information is missing?
c. Can you supply reasonable numbers for any missing information?
d. What is the solution to the problem?

Example: Eleven (11) girls are in the class. Two boys left the class. How many pupils are in the class now?

a. No
b. The number of boys in the class now.
c. 12 boys now
d. 11
+12
23 pupils

1. Gasoline costs $.27 a liter at the local service station. Juan stopped at the station and purchased 20 liters of gasoline and 1 quart of oil. What did Juan's purchases cost?

2. Marita purchased one notebook and five pencils for $1.70. How much did the notebook cost her?

3. Kristin's family went on a 15 kilometer bicycle trip. How many kilometers did the entire family travel?

4. Five thousand runners signed up to run in the Jersey Shore Marathon. The day of the race it snowed and only 3,241 runners were able to finish the course. How many females finished the marathon?

5. Sally and her cousin shared a bottle of soda equally. How many ounces of soda did each person get?

6. How old will twelve year old Maria be 11 years from now?

7. Tom spent 25 cents for a chocolate bar. How much money did he have left to spend?

8. George bought 3 record albums. The albums cost $4.98 each. How much change did he receive?

9. Blueberries sell for 79¢ a pint. Mr. Jones purchased 2 pints. How much did he pay for the blueberries?

Dots, Dots And More Dots

Part A. An ordinary die (singular of dice) has six faces.

1. How many dots are on a die?
2. If someone removes one dot from each face, how many dots will be left?
3. What is the sum of the even numbers on a die?

Part B. This time we will toss two six-sided dice.

1. What is the largest possible sum?
2. What is the largest possible difference?
3. What sum do you think will occur most often?
4. What difference will probably occur most often?
5. What are all the possible sums?
6. What are all the possible differences?

Part C.

1. If you toss four dice what is the largest possible sum?
2. On the dice in the top corners of this page, which numbers are not shown?
3. Do you notice the pattern used to number the faces of a die?
4. If someone doubles the number of dots on each face of a die, what will be the new total number of dots?
5. If someone erases half the dots on the even faces of a die and doubles the dots on the odd faces, what will be the total number of dots?
6. What is the product of the dots on a six-sided die?
7. What are the possible products when two dice are tossed?
8. If you toss ____ dice and the largest possible sum is 72, what is the value of ____ ?

EXTRA!! EXTRA!! EXTRA!!

Read the following problems carefully. Decide which information you need to solve the problem. Cross out any information which is not necessary. Solve the problem.

1. The Avon Farm raises three types of tomatoes to sell at a roadside stand. Last year, sales of Beefsteak tomatoes totaled $1252.75; sales of Ramapo tomatoes totaled $1241.52; and sales of Cherry tomatoes totaled $1143.72. How much more were the sales of Beefsteak tomatoes than Ramapo tomatoes?

2. A stamp collection contains 3225 stamps. Of these, 1732 are American, 572 are Canadian, and more than 400 are from Africa. Exactly how many stamps in the collection are not American?

3. Dave weighs 40 kilograms. He weighed 5 kilograms less last year. His father weighs 95 kilograms. How much more than Dave does his father weigh?

4. A 737 cruises at 530 miles per hour but is capable of speeds up to 570 miles per hour. A 747 cruises at 560 miles per hour. How much slower is the 737's cruising speed?

5. Cinema I seats 220 people. There are 21 showings each week. The theater is 1/4 full. How many people are in the theater?

6. An airplane is carrying 42 passengers, 3 flight attendants, and 480 pieces of luggage. How many passengers must each attendant feed?

7. Sally, Sam, Shirley, and Stu all decide to open their banks. They determine that together they have saved 4045 coins. There are 2483 pennies and over 600 nickels and dimes. Exactly how many coins are not pennies?

8. On her 10th birthday, Beth deposited $10 in her savings account. This gave her a balance of $108.35. On her 11th birthday, Beth's mother will give her $25 to add to her account. How much did Beth have in her savings account before her 10th birthday?

9. Gloria planted 14 geranium seeds. Of the 8 seeds that began to grow only 5 were seeds for red flowered geraniums. How many geranium seeds did Gloria plant?

10. Make up a problem of your own that has extra information.. Ask a classmate to solve it.

GUESS MY RULE

A group game to be played by an entire class:

Step 1. Teacher writes in any digits in the circle line and in the square line.
Step 2. Teacher thinks of a rule to relate the numbers.
Step 3. The teacher writes in the answer for the first two entries. See example.

○	1	3	5	7	6	9	8	0	4	
□	8	4	2	3	0	1	2	6	9	
GUESS MY RULE	8	12								

Step 4. A student volunteer goes to the blackboard to write in the next entry in the third line.
Step 5. Any incorrect answer is erased by the teacher.
Step 6. Repeat steps 4 and 5 until the third line is complete.
Step 7. When the third line is complete, the class states the rule.

Other suggested rules:

○	1	3	5	7	6	9	8	0	4	
□	8	4	2	3	0	1	2	6	9	
○×□	8	12	10	21	0	9	16	0	36	
□-○	7	1	-3	-4	-6	-8	-6	6	5	
○+2×□	17	11	9	13	6	11	12	12	22	
(○+□)+10	19	17	17	20	16	20	20	16	23	
$○^2$+□	9	13	27	52	36	82	66	6	25	
$○^2$+$□^2$	65	25	29	58	36	82	68	36	97	

LET'S COUNT

1. Suppose there is a 100 page book with pages numbered 1, 2, 3, ..., 100.
   a. How many pages contain the digit seven?
   b. How many pages have an even page number?
   c. What digit occurs most often?
   d. What is the total number of digits printed?

2. All of your cousins have exactly the same area code and first three digits of their phone numbers. Each has a different phone number and the last four digits of the numbers form a perfect cube. If all such perfect cubes are used, how many cousins do you have? (for example: 11 x 11 x 11 = 1331, a perfect cube.)

3. The last four digits of your friend's telephone number contain no 0 and sum to 6. What are the 10 possible numbers?

4. If your favorite day is Friday, how many favorite days will you have in 1981?

5. If Ground Hog Day is a Tuesday, on what day of the week will Independence Day fall?

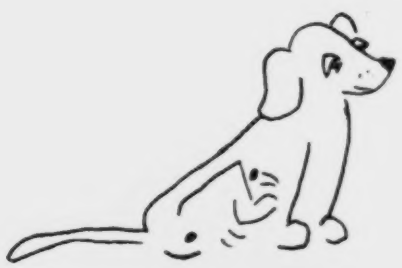
6. From the numbers 1,3,5,7,9 pick any two and form their sum. How many different sums are possible?

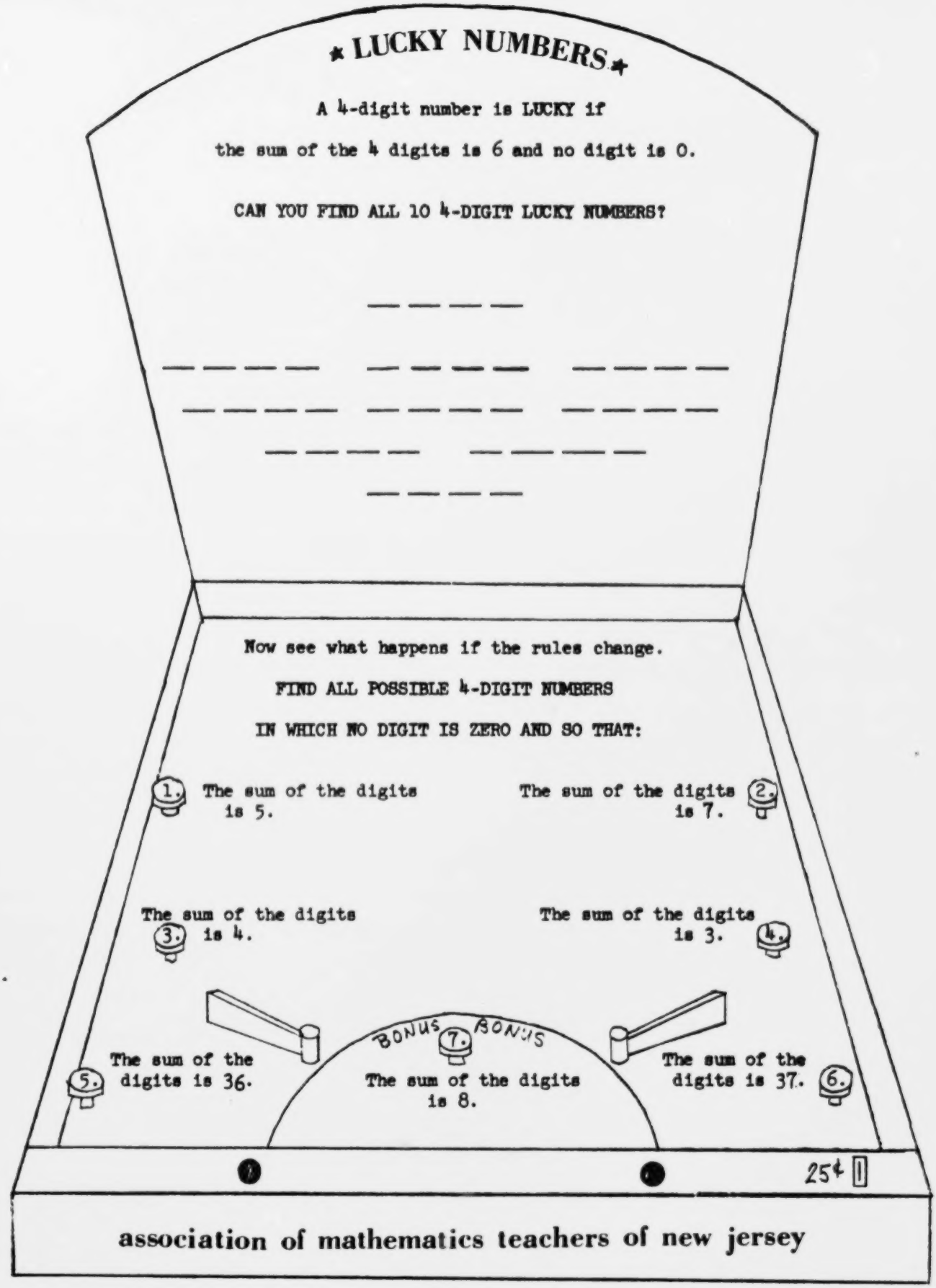
7. Your dog has 2 fleas on July 4 and on every 5th day 3 more fleas arrive. How many fleas will your dog have on August 1, on August 2, on August 4?

8. If two people from your class are to be selected as team captains, how many pairs of captains are possible?

9. If you are 10 years old and I am 28 years old, how old will I be when you are 28 years old?

10. If I have four quarters, three dimes, two nickels and one penny and you have one quarter, two dimes, three nickels and four pennies, how much more money than you have do I have?

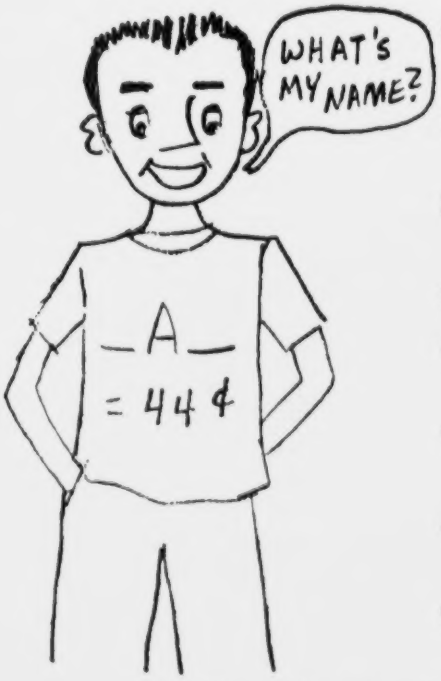



★ LUCKY NUMBERS ★
A 4-digit number is LUCKY if
the sum of the 4 digits is 6 and no digit is 0.
CAN YOU FIND ALL 10 4-DIGIT LUCKY NUMBERS?
Now see what happens if the rules change.
FIND ALL POSSIBLE 4-DIGIT NUMBERS
IN WHICH NO DIGIT IS ZERO AND SO THAT:
1. The sum of the digits is 5.
2. The sum of the digits is 7.
3. The sum of the digits is 4.
4. The sum of the digits is 3.
5. The sum of the digits is 36.
BONUS
7. The sum of the digits is 8.
BONUS
6. The sum of the digits is 37.
25¢
association of mathematics teachers of new jersey

11

N+A+M+E G+A+M+E

A =$.01	G = .09	L = .25	Q = $1.00	V = $1.03
B = .20	H = .12	M = .13	R = .37	W = 1.04
C = .50	I = .03	N = .28	S = .07	X = 1.02
D = .12	J = .23	O = .04	T = .14	Y = .06
E = .02	K = .60	P = .51	U = .14	Z = 2.00
F = .40	Use this chart to answer the following.			



1. What's the value of the word STAR?
2. Drop one letter from the word TONE to make a word costing $ .46.
3. Drop one letter from the answer to problem 2 to make a word costing 18¢.
4. Add one letter to the answer to problem 3 to make a word costing $ .69.
5. What missing letter makes DI_CO a 76¢ word?
6. Which word is the least expensive: SNEAR, ROAST, GLOBE?
7. Change one letter to make HOT a new word costing 55¢.
8. Write as many words as you can in 5 minutes that cost between $1 and $3.
9. Write as many words as you can in 5 minutes that cost exactly $2.

THE NAME GAME CONTEST- Divide the class into teams of 2,3, or 4 players supplying each team member with a dictionary. After each round, points are awarded as follows: FIRST PLACE, 5 points; SECOND PLACE, 3 points, THIRD PLACE, 2 points. After the last round, the winning team is the one with the most points. (Use a 3 minute time limit per round,)
ROUND ONE: What's the most expensive 3 letter word?
ROUND TWO: What's the least expensive 5 letter word?
ROUND THREE: Which team has the most expensive first names?
ROUND FOUR: Write as many words as possible costing between $3 and$4.
ETC.

THE ALIAS GAME- Use the same rules as the Name Game Contest but change the values of the letters.

News Carriers Use Math Every Day

Pretend you are a newspaper carrier. The charts below will help you in your new job.

CUSTOMER RATES	
Mon. to Sat.	$1.20
Sunday	.30
All week	1.50
Magazine	1.00

CARRIER'S EXPENSES	
Carrier insurance	$ .35 (per week)
Papers Mon. to Sat.	.12½ (each day)
Papers Sunday	.26
Magazine	.80

1. How much does the carrier earn at the end of the week if there are 24 Monday to Saturday customers and 30 Sunday customers? Be sure to include the $15 prize money.

Weekly Carrier Invoice

	MON	TUES	WED	THURS	FRI	SAT	DAILY TOTAL	SUNDAY TOTAL	SUNDAY ONLY TOTAL	MON-SAT DAILY TOTAL	TOTAL PAPER CHARGES
PAPERS	24	24	24	24	24	24	144	30	$7.80	$18.00	$25.80

	CARRIER INSURANCE			TOTAL CHARGES
MISC. CHARGES	.35			.35

	PRIZES	INSERTS	TOTAL CREDITS
MISC. CREDITS	15.00	.17	$15.17

TOTAL OF ABOVE	AMOUNT PAST DUE	PAY THIS AMOUNT
$10.98	------	$10.98

How much is earned if the carrier receives $15.00 in tips? Assuming that each customer tips, what is the average tip for the 30 customers?

2. If the carrier is unable to deliver papers on Friday, how much should be paid to a substitute carrier?

3. If an all week customer runs up a bill for two weeks, how much should be collected?

4. How much should be paid a substitute carrier if the regular carrier is on a two week vacation?

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5. How much will a carrier lose if a 6-day customer cancels and the carrier forgets to change the number of papers on the order?

6. A prize of $5.00 is awarded to a carrier for signing up a new customer for ten weeks. If the carrier received $20.00, how many customers were signed up?

7. A pre-schooler in the family used magic marker on three newspapers before the carrier arrived home from school. How much did the carrier lose in total because the papers had to be replaced with newspapers purchased at 20¢ each from the local store?

8. Holiday tips total $135.00 from 30 customers. If it were not a holiday, how many weeks would it take a carrier to collect $135 in tips if the average collected is $15 per week?

9. CONGRATULATIONS!

   You have been promoted to district manager of the news carriers. Fill out the weekly carrier invoice for one of your news carriers and share your results with your classmates and teacher.

Weekly Carrier Invoice

	MON	TUES	WED	THURS	FRI	SAT	DAILY TOTAL	SUNDAY TOTAL	SUNDAY ONLY TOTAL	MON-SAT DAILY TOTAL	TOTAL PAPER CHARGES
PAPERS											

MISC. CHARGES	CARRIER INSURANCE			TOTAL CHARGES	MISC. CREDITS	PRIZES	INSERTS	TOTAL CREDITS

TOTAL OF ABOVE	AMOUNT PAST DUE	PAY THIS AMOUNT

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RIGHT UP SHUBERT'S ALLEY

Two people visit New York City and wish to attend performances of the musicals Annie and Peter Pan. Using the theater directory listings below, fill in the chart.

BEST MUSICAL
1976 TONY & PULITZER PRIZE WINNER
"STILL THE BEST MUSICAL ON BROADWAY!"
—Gussow, N.Y. Times Critic on WQXR, 6/30/1980
N.Y. Shakespeare Festival presents
A CHORUS LINE
TELE-CHARGE: 246-5993
TICKETRON: 977-9020/GROUPTIX 398-7107
Mon.-Sat. 8 PM; Mats. Wed. & Sat. at 2 P.M.
SHUBERT Thea. 225 W. 44th St. 246-5990

7 TONY AWARDS—1977
INCLUDING BEST MUSICAL
N.Y. Drama Critics' Circle Award 1976-77
ANNIE
4th Smash Year!
Tues.-Thur. at 8: $22.50, 19.50, 17.50, 13.50, 11.50. Fri. & Sat. Evgs. at 8: $24, 21, 19, 17, 14. Mats. Sat. at 2, Sun. at 3: $21.50, 18.50, 16.50, 13.50, 11.50. Wed. Mats. at 2: $18.50, 15.50, 13.50, 12.50, 11.50.
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Group Sales Box Office: (212) 398-8383
ALVIN THEA., 250 W. 52 St., N.Y. 757-8646

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BEST ACTOR - JOHN RUBINSTEIN
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An Extraordinary Love Story
Directed by GORDON DAVIDSON
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—Walter Kerr, Times
SANDY DUNCAN as
PETER PAN
The Musical
also starring CHRISTOPHER HEWETT
PRICES: Tues.-Fri. Evgs. at 8 & Mats. Sat. at 2 & Sun. at 3: $22.50, 19, 17, 14. Sat. Evgs. at 8: $25, 22, 20, 17. Wed. Mat. at 2: $20, 17.50, 15.50, 12.50.
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Lunt-Fontanne Thea. 46th St. W. of B'way 586-5555

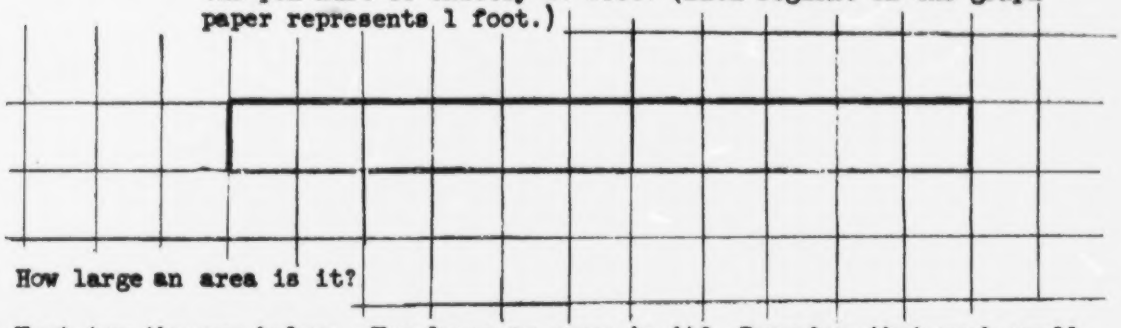
	Annie	Peter Pan	Annie and Peter Pan
Days when no performances are given			
Days when two performances are given			
Highest price seat on least expensive days			
Highest price seat on most expensive days			
Highest price for tickets for two people			
Least amount needed for two people to attend			
Days when matinees are performed			

Room To Roam

Suppose you just received a dog and you wanted to make a pen for it in the shape of a rectangle. If you had only 24 feet of fencing, what is the largest pen you could enclose?

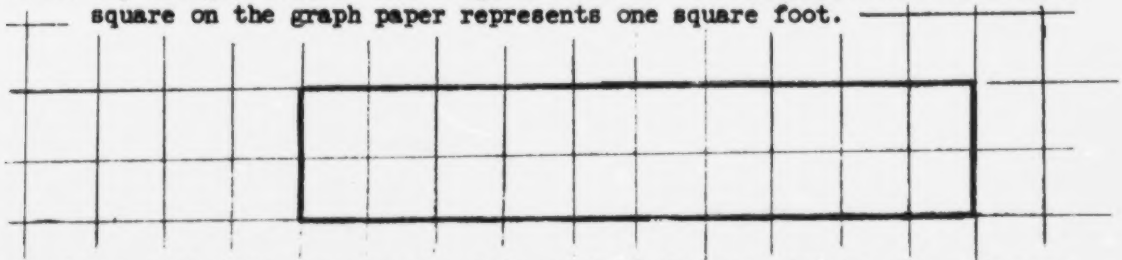
Suggestion- Two good models exist for this problem.
1. Toothpicks can be used - each toothpick represents one foot of fencing- therefore each student needs 24 toothpicks.
2. Graph paper can be used as illustrated below. Each unit on the graph paper represents one foot.

Hint- Start with a pen as illustrated here. Remember that the perimeter of the pen must be exactly 24 feet. (Each segment on the graph paper represents 1 foot.)



How large an area is it?

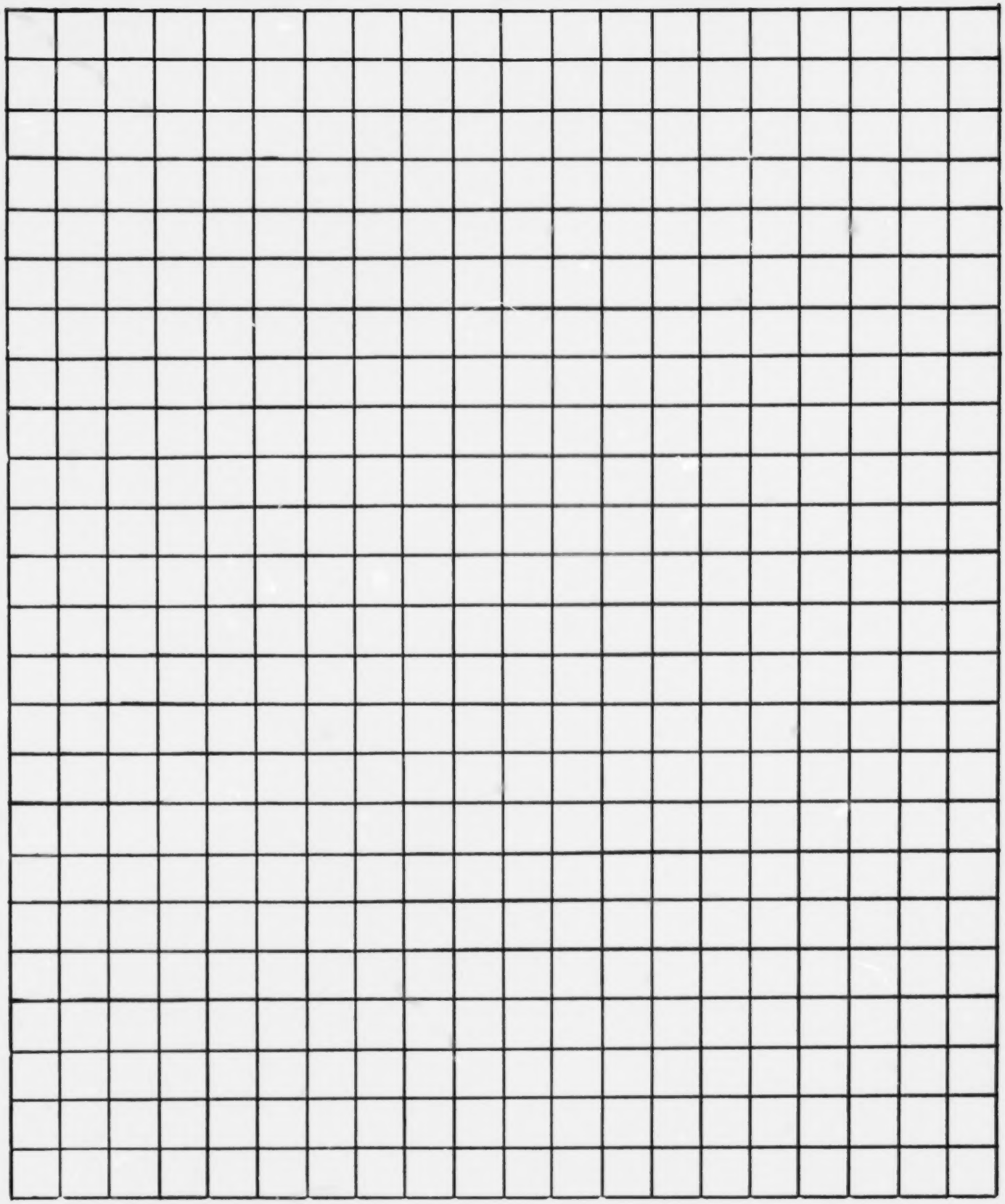
Next try the pen below. How large an area is it? Remember that each small square on the graph paper represents one square foot.



Continue with this experiment until you find the pen with the largest area.

You might find a chart like the one illustrated below helpful.

LENGTH	11'	10'					
WIDTH	1'	2'					
PERIMETER	24'	24'					
AREA	11 sq. feet	20 sq. feet					



SENSE OR NONSENSE

Are these statements reasonable? Explain your answers.

1. Penny's test scores were 75, 80, and 85. Her average score was 90.

2. If 25 people ride in each bus, then 203 busses are needed to carry 575 people.

3. If a 30 foot length of rope costs $20, then a 90 foot length of the same rope costs $60.

4. On a shelf there are 9 boxes of ice cream cones with 12 cones in each box. There are 5 more cones on a table. In all there are 153 cones.

5. Mr. Bragg says he is right 100% of the time. Of course Mr. Bragg is not bragging.

6. Mrs. Thomas jogs 1.3 miles each day. She jogs 15 miles each week.

7. Marge bought a sweater for $17.65. She gave the clerk a $20 bill and 35 cents in change in order to get 3 one dollar bills in return.

8. Mary is having a cookout. She invited six guests. She bought 2 pounds of hot dogs, 2 dozen rolls, and three gallons of mustard.

9. If 100 degrees Celsius is equivalent to 212 degrees Fahrenheit and 0 degrees Celsius is equivalent to 32 degrees Fahrenheit, the outdoor temperature on a summer day is typically 50 degrees Celsius.

10. Sales tax is 5 cents on a dollar. The sales tax on a $100 sale is $5.

WHO TOOK THE DOLLAR?

Note: This is a classic problem which is totally dependent on the misdirection created by the storyteller.

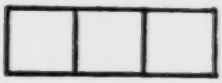
Three people rent a hotel room. The room clerk states that the rate is $30 for the room. Each person therefore pays ten dollars. Later the clerk discovers an error- the cost should have been $25. The bellhop is sent to the room with the $5 refund. On the way the bellhop reasons- it's difficult to divide $5 among three people. Therefore the bellhop pockets $2 and returns $3 to the hotel guests. Each guest therefore received a $1 refund. Obviously each guest paid $9 for the room. Nine dollars times 3 for the three people is $27 plus $2 pocketed by the bellhop is $29. WHO TOOK THE DOLLAR??

SQUARES-RECTANGLES-TRIANGLES

1. How many rectangles are in the following figure?

Are there more than 5? Why?

How many look like this?

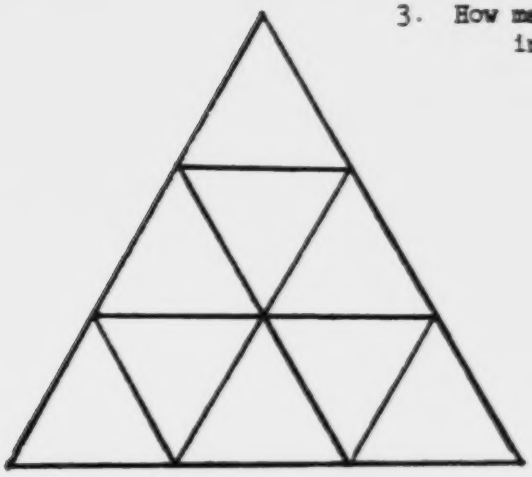
How many look like this? 

Now can you answer the original question?

2.

a. How many squares are in this figure?
b. How many rectangles?

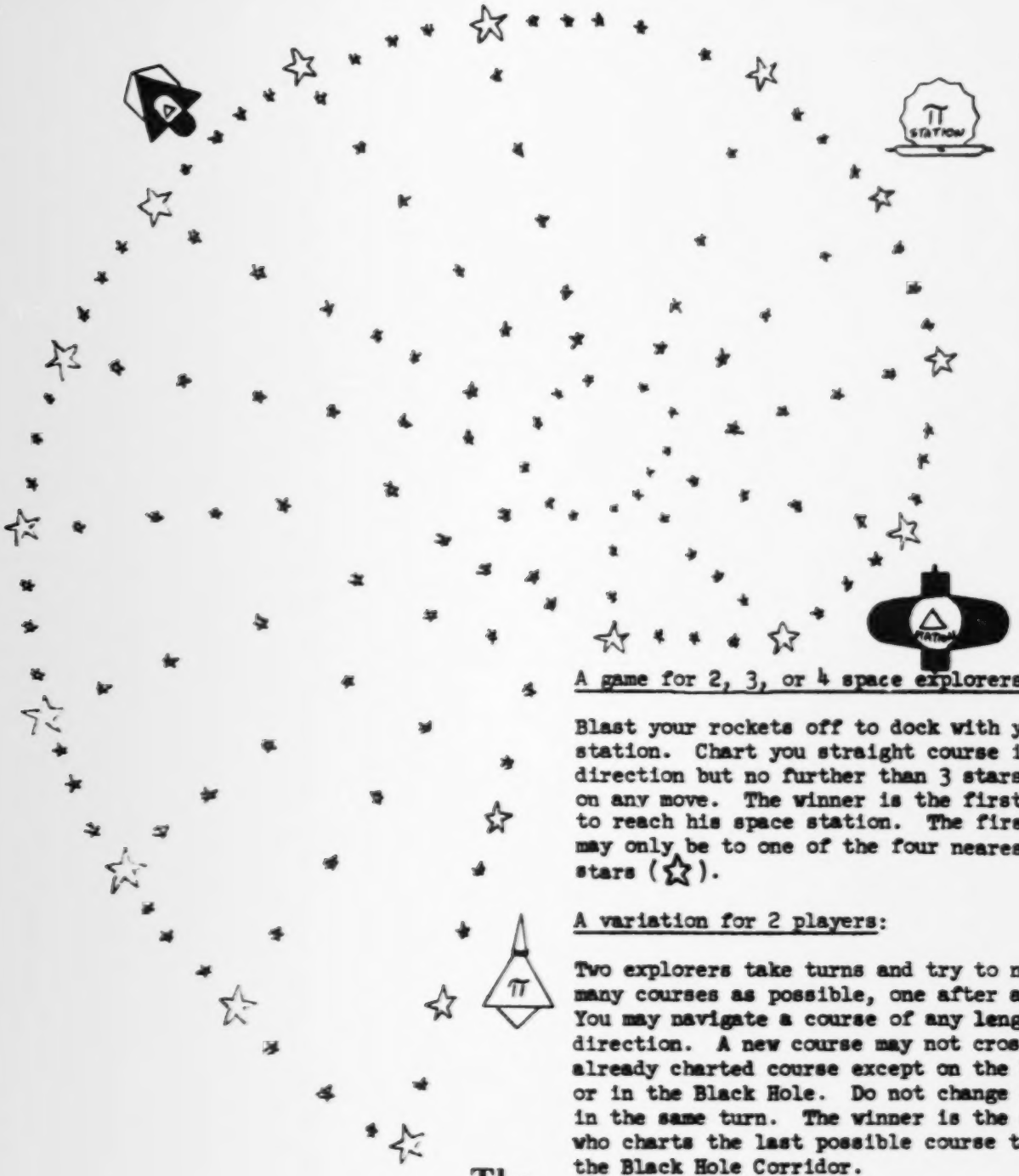
3. How many triangles are in this figure?



Supermarket Math

Complete the chart:

	Super Discount Price	Regular Supermarket Price	Savings	Amount Saved if ten items were purchased at the lower price
Wyler's Lemonade Drink Mix 1 lb. 8 oz. canister	$1.49	$1.72	23¢	$2.30
Royal Butter 1 pound package	1.67		14¢	
Seneca Apple Cider 2 cans (frozen)	2 cans for 89¢	2 cans for 99¢		
Nabisco Wafers 15 ounce package	1.08	1.39		
Diet 7-Up 2 liter bottle		1.39	24¢	
Purex Liquid Bleach 1 gallon container	68¢	79¢		
Wet Ones package of 70	1.09		20¢	
Parkay Margarine 1 pound package		79¢	21¢	
Trix Cereal 12 ounce package	1.19	1.30		
Italian Olives 2 pound jar	1.19			2.00
TOTAL				



The Black Hole Corridor!

association of mathematics teachers of new jersey

A game for 2, 3, or 4 space explorers:

Blast your rockets off to dock with your space station. Chart you straight course in any direction but no further than 3 stars in length on any move. The winner is the first explorer to reach his space station. The first move may only be to one of the four nearest major stars (☆).

A variation for 2 players:

Two explorers take turns and try to navigate as many courses as possible, one after another. You may navigate a course of any length in any direction. A new course may not cross an already charted course except on the boundary or in the Black Hole. Do not change direction in the same turn. The winner is the explorer who charts the last possible course through the Black Hole Corridor.

Space Corridor Claiming:

Every explorer selects a space number. Each explorer takes turns drawing stellar boundaries between adjacent stars (stars that are next to each other). When an explorer encloses a space containing no stars, it is labeled with the space explorer's space number. After the last claim is made, spaces are totaled. The winner is the explorer who has the most spaces.

MAY THE FORCE BE WITH YOU!

1. Which record is cheaper OFF THE RADIO or OH, SUZANNA? How much cheaper is it?

2. How much will it cost to buy BEST OF BEAGLES, UR MY SUNSHINE and CANDY NO?

3. How much do you save over the regular price by buying OFF THE RADIO and BEST OF BEAGLES at the sale prices?

4. For one hour only each record costs 1/2 of the regular price. How much do you save over the listed sale price by buying a code C album during the next hour?

5. BEST OF JERSEY is a code C double record set not on sale. How much does the album cost? If the set were on sale, what would its cost be?

6. How much change should you receive after paying for OFF THE RADIO at the sale price with a $10 bill?

7. How much change should you receive from $10 after paying for GLASS HORSES and OH, SUZANNA at sale prices?

8. How much change should you receive from $10 if you buy 3 code A albums at sale prices?

9. What's the greatest number of records you can purchase at sale prices with $20?

10. If your mother lends you enough money to buy STYX STYCKS for yourself and OFF THE RADIO for your friend's birthday gift, how many weeks will it take to pay off your loan if you pay back 50¢ per week?

THE MOVIES

John (age 15), Nancy (age 11), and Kevin (age 7), decided to go see the new Star Wars movie. The two charts show what the theater charges for admission tickets and refreshments.

TICKETS

	Before 1:00 p.m.	All Other Times
Adults	$1.50	$4.00
Children (Under 12)	$1.00	$2.00

REFRESHMENTS

POPCORN	small	60¢*
	large	80¢*
	*butter	10¢ extra
CANDY		50¢
SODA	small	50¢
	medium	80¢
	large	1.00
ICE CREAM		75¢

(All prices include sales tax)

1. How much money do John, Nancy, and Kevin need to purchase admission tickets to the half past noon show?

2. They brought an additional five dollars to purchase refreshments. Kevin had a large popcorn with butter and a small soda, Nancy had candy, ice cream, and a small soda, and John had ice cream and a large soda. How much change was left from $5.00?

3. Whose refreshments were most expensive?

4. Whose refreshments were least expensive?

5. If John, Nancy, and Kevin had decided to go to the 4 p.m. show, how much would they have had to pay for the admission tickets? How much money did they save by attending the 12:30 show?

6. How much money would they need to attend the 4 p.m. show and have the same refreshments that are listed in problem number 2?

7. How much money would they need to attend the 4 p.m. show and each enjoy the following refreshments: a large popcorn (with butter), candy, a small soda, and an ice cream?

8. John, Nancy, and Kevin usually attend the 12:30 show three times a month. How much do they spend for admission tickets each month?

Using Codes to Convey Information

TABLE 1

Index Number	(10^0) Age Range	(10^1) Educational Level	(10^2) Field	(10^3) Years of Experience
1	15–20	1–8	Physics	1–2
2	21–25	9–12	Chemistry	2–3
3	26–30	Associate	Bio/Med	3–4
4	31–35	Bachelor	Math	4–5
5	36–40	Master	Lang/Lit	5–6
6	41–45	PhD	Bus/Comm	6–7
7	46–50	MD	Art/Music	7–8
8	51–60	ScD	Skill/Craft	8–9
9	61–	LLD	Law	9–

TABLE 2

Category	Position of Digit in the Code
Age Range	10^0
Weight Range	10^1
Height Range	10^2
Hair Color	10^3
Interest in Music	10^4

TABLE 3

Code Number	(10^0) Age Range	(10^1) Weight Range	(10^2) Height Range	(10^3) Hair Color	(10^4) Interest/Music
1	under 12	30–45 kg	100–119 cm	short blond	does not play
2	12	46–50	120–129	med. blond	plays piano
3	13	51–55	130–139	long blond	plays strings
4	14	56–60	140–149	short brown	plays guitar
5	15	61–65	150–159	med. brown	plays brass
6	16	66–70	160–169	long brown	plays drums
7	17	71–80	170–179	short blk	plays clar/sax
8	18	81–90	180–189	med/lg blk	plays flute
9	19+	91–	190–	red	plays organ

Coding is a compact method of conveying a variety of characteristics about a person or object. The place or position occupied by each symbol (digit) determines its meaning, just as the position of a digit in our familiar decimal system reflects its place value. If we write $6518 = 6 \times 10^3 + 5 \times 10^2 + 1 \times 10^1 + 8 \times 10^0$, we know very clearly the value of each digit. In a skills index, a number like 6518 refers to four different categories of information about a person. For example, if a code is defined as in table 1, then 6518 represents a person 41-45 years of age with a master's degree, a major in physics, and eight to nine years of experience. This type of coding, with even more digits in the code, can be of great use to large companies in storing information about job applicants.

To convey the importance of coding, to reinforce and extend the idea of place value and exponential notation, and to review measurement in metric units, try the following.

Procedure

1. Review the meaning of place value and exponential notation.
2. Have students measure their weights and heights in metric units.
3. Give a detailed explanation of table 2.
4. Generate an identifying code for each person based on the code in table 3.

Class activities

1. Have students code their own descriptions (their brothers and sisters, also).
2. Have students identify individuals from description numbers given:
3. Make a report relating coding as an important technique for business to use in finding the right person for specific job requirements.
4. Make a coding table with a different set of descriptions.

Gloria Sanok in The Mathematics Teacher,
Volume 71, Number 7, Oct. 1978

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ANSWER KEYS

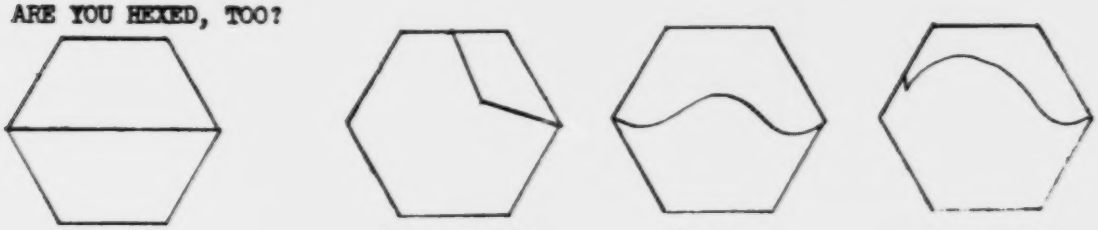
Answers are listed alphabetically by title.

ARE YOU FOR REAL?

The numbers selected in step 1 determine the answers. Note: The numbers shown below represent reasonable numbers that could be selected for step 1.

1. 2,12 2. 3, 2 3. 13, 4 4. 2 5. 500, 6. $6, 45
7. 57,145 and 76,713 8. 2, 3, 5 9. 5000, 5000 10. 19

ARE YOU HEXED, TOO?



top lower right bottom upper right

CENTS AND NON-CENTS

1. $9.18 2. $8.88 3. $3.80 4. $19.59

In response to the suggestion regarding starting with 50 pennies and 100 pennies: the total amount on the table after 5 exchanges with 50 coins is $15.09 and with 100 coins is $30.11.

Eight Penny Pick-up: The key to the strategy is for you to pick up the seventh penny therefore leaving the eighth for your friend-- thus your friend loses. To accomplish this you go first and pick up 3 pennies. If your friend now picks up 1, you pick up 3 on your next turn. If your friend picks up 2, you pick up 2. If your friend picks up 3, you pick up 1. Now there is only 1 left and your friend must pick it up and lose.

Catch 52: The strategy is for you to go first and choose three. Now whatever your opponent chooses, you choose the number, which when added to the opponent's number, brings the total to 7. If this is continued, you will pick the number which makes the sum 52 and you become the winner.

THE DEPARTMENT OF MISSING INFORMATION

(Note: Information provided in step c may vary from the information shown in these answers.)

1. a. No
   b. Cost of oil
   c. $1.00
   d. $ .27
      x 20
      $5.40
      + 1.00
      $6.40

2. a. No
   b. Cost of the pencils
   c. $ .50
   d. $1.70 - .50 = $1.20

3. a. No
   b. How many in family
   c. 3 people
   d. 15
      x 3
      45 kilometers

4. a. No
   b. How many males finished
   c. 1,705
   d. 3241
      -1705
      1536 females

5. a. No
   b. How large is bottle
   c. 64 ounces
   d. 64 divided by 2=
      32 ounces each

DEPARTMENT OF MISSING INFORMATION continued

6. a. Yes
   b. and c. Omit
   d. 12+11=23 years old

7. a. No
   b. How much did he have to spend
   c. $1.00
   d. $1.00 - .25= $ .75 left

8. a. No
   b. How much money did he have to purchase the records
   c. $20.00
   d. $4.98 x 3 = $14.94 ; $20.00 - 14.94 = $ 5.06

9. a. Yes
   b. and c. omit
   d. $.79 x 2 = $1.58

DOTS, DOTS AND MORE DOTS

Part A. 1. 1 + 2 + 3+ 4 + 5 + 6 =21 An interesting alternate method is to observe that 1 + 6 = 7, 2 + 5 = 7, and 3 + 4 = 7. Thus the total is 3 x 7 = 21.
2. Method I. 21 - 6 =15 Method II. 0 + 1 + 2 +3 + 4 + 5 = 15
3. 2 + 4 + 6 = 12

Part B. 1. 6 + 6 = 12 2. 6 - 1 = 5 3. 7 is the correct answer but any answer such as 6, 7, or 8 is a good guess. (see the solution to #5)
4. 1 is the correct answer (see solution to #6)
5. 2,3,4,5,6,7,8,9,10,11, and 12. See the table below.

+	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

6. 0,1,2,3,4,5 are possible differences. A table such as used in #5 will help.

Part C. 1. 4 x 6= 24 2. top left 1,2,4 top right 3, 5, 6
3. The numbers on opposite faces sum to 7. 4. 42 5. 24 6. 720
7. 1,2,3,4,5,6,8,9,10,12,15,16,18,20,24,25,30,36 8. 12

EXTRA!! EXTRA!! EXTRA!!

1. $1252.75 - 1241.52 = $11.23 more
2. 3225 - 1732 = 1493 stamps
3. 95 -40 = 55 kilograms more
4. 600 - 500 = 100 MPH slower
5. 220 x 1/4 = 55 people
6. 42 + 3 = 14 passengers each
7. 4045 - 2483 = 1562 coins
8. $108.35 - 10.00 = $98.35
9. 14 geranium seeds
10. These problems are student generated. Thus the answers will vary.

LET'S COUNT

1. a. 19 b. 50 c. 1 d. 190
2. 12 3. 1113, 1131, 1311, 3111, 1122, 2211, 1221, 2112, 1221, 2121
4. 52 5. Sunday 6. 7 7. 17, 17, 20 8. If the class has 20 children, then 19 + 18 + 17 + 16 + ... + 2 + 1 = 190 9. 46 10. 77¢

LUCKY NUMBERS

First problem: 1113, 1131, 1311, 3111, 2211, 2112, 1122, 1212, 2121

1. 1112, 1121, 1211, 2111 2. 1114, 1141, 1411, 4111, 2122, 2221, 2212, 1222, 1231, 3211, 3112, 3121, 2311, 2131, 2113, 1321, 1132, 1123

3. 111 4. there are no such numbers 5. 9999 6. there are no such numbers (At this point, the teacher might ask the class to find all lucky numbers so that the sum of the digits is 38, 39, ...)

7. 3311, 3131, 1133, 1331, 3113, 1313, 2222, 1115, 1151, 1511, 5111, 1124, 1142, 4211, 2411, 4112, 1412, 1421, 4112, 2141, 2114, 1241, 1214

NAME GAME

1. 7 + 14 + 1 +37 = 59¢ 2. 14 + 4 + 28 + 2 = 48, 48-46=2¢=E

3. 46-18=28¢=N write TO 4. 14 + 4 = 18, 69-18=51=P, write TOP (POT and OPT are not answers because the directions say only to add a letter, not to add and rearrange.) 5. 12 + 3 + 50 + 4 = 69, 76-69=7=S 6. SNEAR = 75¢, ROAST = 63¢, GLOBE = 60¢ so the answer is GLOBE 7. HOT=30¢, 25¢ more is needed, examine the three possibilities:

H+O+T	H+O+T	H+O+T	
12+4+14	12+4+14	12+4+14	
+25	+25	+25	
37=R	29= no letter	39= no letter	the answer is ROT

8. answers vary. some examples are: CLUB=1.09, ZOO=2.08, BELIEVE=1.57

9. This is a very difficult question. Use it for all it's worth. It is probable that no student will find such a word without extra time outside of class. Provide that opportunity: turn the question into a contest. The English department certainly won't complain if your students can't wait to use the dictionary. One answer is WRAPS. (The boy in the illustration is named RAY. Strategy: try Pat, Ray, Sam, Dan and seek two letters whose sum in 44-1 or 43.)

NEWS CARRIERS USE MATH EVERY DAY

1. $1.20 x 24 = $28.80; $.30 x 30 = $9.00; $28.80 + 9.00 = $37.80; $37.80 - 10.98 = $26.82 first answer; $26.82 + 15.00 = $41.82 second answer; 30) $15.00 = $.50 third answer

2. Each student will have his own rational for this problem. Some may have found you must pay someone more because it is hard to find a replacement, others may give the person less. Good for class discussion. 3. $1.50 x 2 = $3

4. Like problem two, some do not want others collecting their money (and tips). Good class discussion. 5. $.12½ x 6 = $.75 6. 5) $20.00 = 4 customers

7. Since the customer pays 20¢ each, the money paid to the store will cancel out, so the carrier must pay 37½¢ or 38¢ to the paper for the destroyed papers.

8. $15.00) $135.00 = 9 9. Answers will vary.

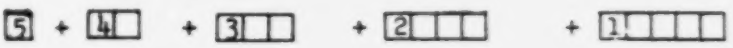
RIGHT UP SHUBERT'S Alley

Monday	Monday	
Wednesday, Saturday	Wednesday, Saturday	
$18.50	$20.00	
$24.00	$25.00	
$48.00	$50.00	$98.00
$23.00	$25.00	$48.00
Wednesday, Saturday and Sunday	Wednesday, Saturday and Sunday	

ROOM TO ROAM
The largest pen is a square 6 feet by 6 feet whose area is 36 square feet.

SENSE OR NONSENSE
1. not reasonable 2. not reasonable 3. very reasonable 4. not too reasonable 5. not very reasonable 6. not reasonable 7. not reasonable 8. not very reasonable 9. not reasonable 10. reasonable

SQUARES-RECTANGLES-TRIANGLES

1.  = 15

2a. 14 2b. 45 3. 13

SUPERMARKET MATH

Wyler's Lemonade	$1.49	$1.72	23¢	$2.30
Royal Butter	1.67	1.81	14¢	1.40
Seneca Apple Cider	2/89¢	2/99¢	5¢/can	.50
Nabisco Wafers	1.08	1.39	31¢	3.10
Diet 7-Up	1.15	1.39	24¢	2.40
Purex Bleach	68¢	79¢	11¢	1.10
Wet Ones	1.09	1.29	20¢	2.00
Parkay Margarine	.58	79¢	21¢	2.10
Trix Cereal	1.19	1.30	11¢	1.10
Italian Olives	1.19	1.39	20¢	2.00
TOTALS	11.01	12.86	1.80	18.00

THE RECORD RACK
1. OFF THE ROAD, 79¢ cheaper 2. $4.99 + 4.20 + 3.49 = $12.68 3. total regular price ($10.96) less total sale price ($9.19) equals $1.77 savings 4. $2.00 ($4.99 - 2.99 = $2.00) 5. $11.96, $9.98 6. $5.80 change 7. $10.00 - (3.49 + 4.99) = $1.52 change 8. you cannot buy 3 code A albums with $10.00 9. Since $3.49 x 6 = $20.94 is greater than $20, and $3.49 x 5 = $17.45, 5 is the greatest number of albums one may purchase. 10. $3.49 + 4.20 = $7.69, $7.69 + 50¢/week = 15.38 or 16 weeks.

THE MOVIES

1. John - $1.50
   Nancy - 1.00
   Kevin - 1.00
   $3.50

2. Kevin $.90 + .50 = $1.40

   Nancy $ .50 + .75 + .50 = $1.75

   John $ .75 + 1.00 = $ 1.75

   $1.40 + 1.75 = $4.90

   $5.00 - 4.90 = $ .10 Change left

3. Nancy and John

4. Kevin

5. John - $4.00
   Nancy - 2.00
   Kevin - + 2.00
   $8.00 Admission to 4 p.m. show

   $8.00 - 3.50 = $4.50 saved by going to the 12:30 show

6. $ 8.00 Admission
   + 4.90 Refreshments
   $ 12.90

7. $ .90 + .50 + .50 + .75 = $2.65

   $ 2.65 x 3 = $ 7.95 Refreshments

   $ 7.95 + 8.00 Admission = $ 15.95

8. $ 3.50 x 3 = $ 10.50

WHO TOOK THE DOLLAR?

The misdirection is created when it is suggested that the $2 the bellhop pocketed should be added to the $27 paid by the three people when, in fact, if the $2 is subtracted it leaves $25. The $25 plus the $3 returned to the hotel guests plus the $2 the bellhop took makes the total of $30. Nothing is lost!